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FUMIGATION OF ORNAMENTAL GREENHOUSE PLANTS WITH HYDROCYANIC-ACID GAS.

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INTRODUCTION.

Hydrocyanic-acid gas, if intelligently employed, is one of the cheapest and most efficient methods of controlling thrips, aphids, white flies, and various scale insects on plants grown under glass. That this method of control has not been generally adopted is no doubt owing to the deadly poisonous nature of the gas if inhaled, its disastrous effect on tender plants if improperly used, and the pre-

NOTE.—Hydrocyanic-acid gas was first used against greenhouse pests in 1895 by Messrs. A. F. Woods and P. H. Dorsett (see Circular No. 37, Bureau of Entomology, U. S. Department of Agriculture) in an effort to destroy insects on diseased plants under observation. Subsequently others have employed the gas in greenhouse fumigation, but with varying success, largely because of inexperience and improper methods of procedure. In the earlier experiments in greenhouses conducted by the Bureau of Entomology the senior author was assisted by Mr. H. L. Sanford, of the Federal Horticultural Board, and by Messrs. Eugene May, W. R. Lucas, and Charles Keller, of the Bureau of Plant Industry. The spelling of the botanical names used in this publication has been verified by Messrs. P. L. Ricker and H. C. Skeels.

CAUTION.—*Hydrocyanic-acid gas is colorless and is one of the most deadly poisonous gases known. It has an odor much like that of peach pits. In case of accidental inhalation of the gas, the person affected should be kept in the open air and required to walk to increase respiration.*

vailing impression that fumigation is a cumbersome procedure requiring considerable skill on the part of the operator. While it is true that much damage to the plants and injury to the operator may result from the *careless* use of hydrocyanic-acid gas, it is an established fact that this fumigant in competent hands is a safe, practical, and economical means of controlling virtually all insect pests found in greenhouses.

EQUIPMENT NECESSARY FOR FUMIGATION.

GENERATORS.

One-half gallon or one-gallon glazed earthenware jars serve as satisfactory generators, although it is preferable that the bottoms of the jars be rounded inside, so that the cyanid will be covered with the acid and water, even with small doses, thus insuring the maximum generation of the gas. The number of generators required is largely influenced by the size of the house or houses to be fumigated, and to avoid unnecessary delay in case of breakage several extra crocks should be available.

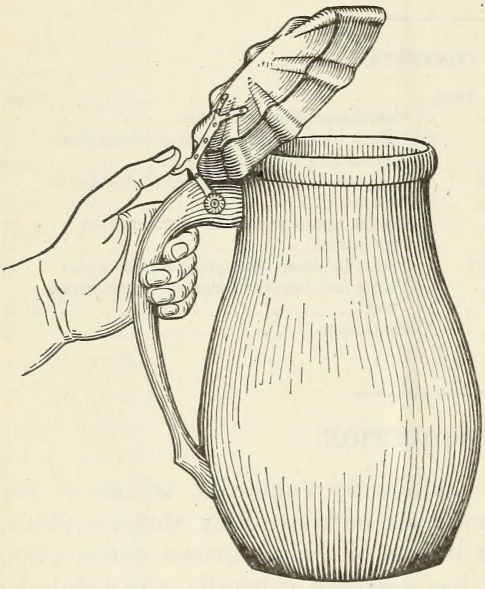

FIG. 1.—A cover device attached to a fumigation generator. Corrugations in cover allow gas to escape. (Woglum.)

To insure uniform distribution of the gas it is advisable to employ generators with covers, such as that illustrated in figure 1. This cover, which was designed by Mr. R. S. Woglum,[1] is made of copper stamped in a concave form with corrugations to permit the escape of the gas. It is attached to the generator by hinges and held in place by a bolt which extends through the handle and can be raised by a slight pressure of the thumb as shown in the figure. If it is not possible to secure crocks of this description, those with straight sides which are not constricted inside at the bottom can be used with good results, although to insure complete generation such a crock should be tilted slightly in order that the cyanid may be covered. Crocks

[1] Bul. 79, Bur. Ent., U. S. Dept. Agr., p. 58, fig. 21, 1909. Bul. 90, Part I, Bur. Ent., U. S. Dept. Agr., p. 75, fig. 12, 1911.

with straight sides are frequently sold with glazed earthenware tops. These tops or covers increase the cost of the generators and, furthermore, are useless for fumigation purposes. Therefore, when generators are ordered it should be indicated that tops are not desired. With this type of generator a cover may be improvised by using a piece of corrugated galvanized iron roofing or a board with cleats on the underside, to allow the free exit of gas.

MISCELLANEOUS REQUIREMENTS.

Correct scales or balances, reading in tenths of an ounce, are convenient for accurate work. An 8-ounce graduate is desirable for measuring the acid and water. To avoid splashing of the acid it should not be poured from a carboy or bottle into the graduate but should be transferred to a porcelain pitcher, from which it may be poured with safety. It is well to have on hand a supply of small bags or tissue paper in which to place the cyanid.

PREPARATION OF HOUSE FOR FUMIGATION.

As a preliminary to fumigating the house it is essential that the exposed glass surface be examined carefully and all broken glass replaced. All cracks should be thoroughly closed. The ventilators,

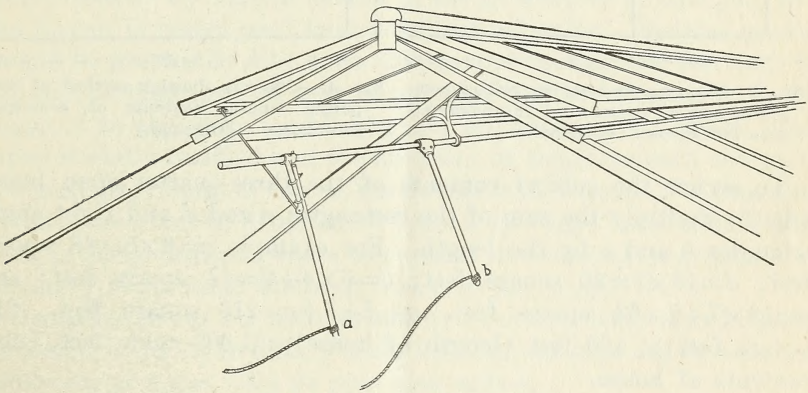

FIG. 2.—Methods of attaching rod and cord (*a*, *b*) to ventilator shaft of greenhouse so that the ventilators can be opened from the outside after fumigation. (Original.)

both side and top, where possible, should be so arranged that they can be opened on the outside of the house upon the completion of the exposure. This can be accomplished by disconnecting the "machine," or gear, of the top ventilators and attaching to the central ventilator shaft (see fig. 2) an arm (*a* or *b*) which can be controlled by a cord or wire which extends through the side of the house. The gears on the side ventilators may be disconnected so that the sash may be opened from the outside. If only one ventilator can be opened it is preferable that it be the one on the roof of the house.

METHOD OF COMPUTING THE CUBICAL CONTENTS OF EVEN AND THREE-QUARTER SPAN GREENHOUSES.

It is essential in every instance that the cubical contents of the house to be fumigated be determined accurately, and the following is a simple method of arriving at these figures: To facilitate matters a diagram indicating the necessary dimensions of the house should be made. (See figs. 3 and 4.)

To secure the cubical contents of the even-span house (fig. 4), compute the number of square feet in the rectangle *a* and in the right-angle triangles *b* and *c* and multiply the sum of the three by the length of the house. For example, A=5×20=100 square feet; B=5×10÷2=25 square feet[1]; and C=5×10÷2=25 square feet. A+B+C=150 square feet. 150 square feet × 100 feet (length of house)=15,000 cubic feet, cubic contents of the house.

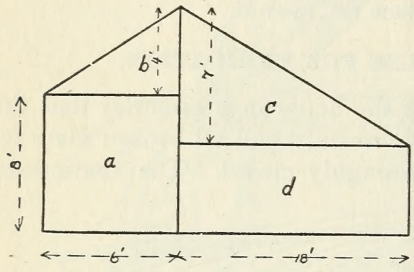

FIG. 3.—Diagram showing method of computing cubical contents of three-quarter-span greenhouse. (Original.)

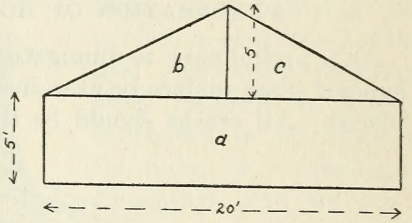

FIG. 4.—Diagram showing method of computing cubical contents of even-span greenhouse. (Original.)

To secure the cubical contents of the three-quarter span house (fig. 3) multiply the sum of the rectangles *a* and *d* and right-angle triangles *b* and *c* by the length. For example *a*=6×8=48 square feet; *d*=18×5=90 square feet; *b*=6×4÷2=12 square feet; and *c*=18×7÷2=63 square feet. *a*+*d*+*b*+*c*=213 square feet. 213 square feet × 100 feet (length of house)=21,300 cubic feet, cubic contents of house.

In estimating the cubic contents of a greenhouse it is not necessary to make allowances for the space occupied by the benches, pots, etc.

TIME FOR FUMIGATION.

Fumigation should be conducted not earlier than one hour after sunset and should not be attempted when the wind is high. It is undesirable to fumigate during extremely cold nights, when the thermometer is registering near zero, owing to the necessity of ven-

[1] To calculate the area of a right-angle triangle, multiply the base by the perpendicular and divide the product by two.

tilating the houses upon the completion of an exposure. It is inadvisable to fumigate on hot, humid nights, when the temperature in the house can not be lowered readily to the desired limit. The best temperature for fumigation is between 55° and 68° F.

The interval between fumigations naturally should be governed by the reappearance of the insect under control. With small dosages, which are imperative when fumigating a house containing an assortment of plants, it is possible to kill only the larvæ of scale insects, the adults and first larval stages of the greenhouse white fly, the adults of the Florida fern caterpillar, greenhouse leaf-tyer, and loopers, and a certain percentage of aphids. The eggs and pupæ of most greenhouse insects offer considerable resistance to hydrocyanic-acid gas, and furthermore the overlapping of broods necessitates several fumigations at short intervals. It has been proved repeatedly that three or four fumigations at short intervals will give practical control.

CHEMICALS REQUIRED FOR FUMIGATION.

The chemicals required in fumigating with hydrocyanic-acid gas are sodium cyanid (NaCN) or potassium cyanid (KCN), sulphuric acid (H_2SO_4), and water (H_2O). Potassium cyanid has been superseded recently by sodium cyanid in the generation of this gas, and the former is rarely used nowadays in fumigation. Sodium cyanid should be practically free from chlorin and contain not less than 51 per cent of cyanogen. It may be purchased either in lumps or in the shape of an egg, each "egg" weighing approximately 1 ounce. The latter is easily handled and the necessity of weighing each charge is obviated, providing, of course, the dosage is in ounces. For example, if the house requires 10 ounces of cyanid, 10 "eggs" are used. However, in small dosages, where the cyanid is measured in grams, it is necessary to use small lumps or break up the "eggs."

Cyanid is one of the most poisonous substances known and should be stored in air-tight cans, plainly labeled, and kept out of reach of those unacquainted with its poisonous nature.

Commercial sulphuric acid (about 1.84 sp. gr. or 66° Baumé) which is approximately 93 per cent pure is commonly used and gives very satisfactory results. The acid should be kept in a glass receptacle, properly labeled, and tightly corked with a glass stopper.

DETERMINING THE AMOUNT OF CYANID TO BE USED.

Satisfactory results are obtained only where it is possible to overcome the resisting power of the insects without overcoming the resisting power of the plant. Tender succulent plants, such as roses, geraniums, coleus, sweet peas, Wandering Jew, etc., are more susceptible to injury by hydrocyanic-acid gas than are certain hardy ornamentals,

and this fact should be considered where an assortment of plants is to be fumigated. In case there is any doubt as to the amount of gas a plant will stand without injury, it is preferable that the initial dosage be not over one-fourth ounce of sodium cyanid per 1,000 cubic feet and increased with subsequent fumigations until the fatal point of the pest to be controlled is reached, it being borne in mind that in some instances it is not possible to effect an absolute control of all stages of some insects with one fumigation without injury to foliage or growing parts of certain plants. For example, the greenhouse white fly has been eradicated with three successive fumigations at intervals of 7 to 9 days, using one-half ounce of sodium cyanid (NaCN) per 1,000 cubic feet, in houses containing such susceptible plants as coleus, ageratum, heliotrope, fuchsia, etc., with no injury to the foliage. Moreover, such resistant pests as scale insects can be eliminated entirely by killing the immature stages with a small dosage repeated at frequent intervals.

Under favorable conditions houses which do not contain roses, rose geraniums, asparagus ferns, lemon verbena, snapdragon, Wandering Jew, or sweet peas can be fumigated with safety with an initial dosage of one-half ounce of sodium cyanid (NaCN) per 1,000 cubic feet.

To determine the total amount of cyanid to be used, ascertain from the tables on pages 12–18 the plants in your greenhouse which are most easily injured by the gas fumes and note the amount of cyanid which was used per 1,000 cubic feet with little or no injury to the plants. Then multiply the number of thousand cubic feet contained in the house by the amount of cyanid to be used per 1,000 cubic feet. For example, if one-half ounce of cyanid is to be used per 1,000 cubic feet, and the house contains 15,000 cubic feet, the total amount of cyanid necessary would be 7½ ounces.

In case there is any doubt as to the amount of gas the plant can stand without injury, the initial dosage, as previously stated, should not exceed one-fourth ounce per 1,000 cubic feet.

CHEMICAL FORMULA TO BE EMPLOYED.

The chemicals[1] should be mixed in the following proportions: For each ounce of sodium cyanid use 1½ fluid ounces of sulphuric acid and 2 fluid ounces of water.

[1] If potassium cyanid is used in place of sodium cyanid, the formula should be as follows: For each ounce of 98 to 99 per cent potassium cyanid containing 38.4 per cent cyanogen use 1 ounce of sulphuric acid and 3 ounces of water. The yield from 1 ounce of high-grade sodium cyanid is equivalent to the yield from 1⅓ ounces of high-grade potassium cyanid.

MIXING THE CHEMICALS.

After the generators have been distributed throughout the greenhouse, and before the chemicals have been mixed, the cyanid should be weighed accurately and the proper amount for each generator placed in a paper bag near the generator. The chemicals should be mixed invariably in the following manner: First, measure and place in each generator the amount of water required; second, measure and place in each generator the amount of sulphuric acid required; third, drop the cyanid into the diluted warm acid in each generator, close the covers, immediately leave the house, and post a danger sign on the closed door. The cyanid should be dropped gently, not thrown, into the generators, and the operator should begin at the generator farthest from the door and work toward the door. In case there are two rows of generators the cyanid should be dropped simultaneously by two operators. As little time as possible should elapse between the addition of the acid and the addition of the cyanid, as the heat which is liberated by the mixing of the acid and water assists in the generation of the gas.

The residue left in the generators after fumigation should be buried or poured into a sink and the generator washed before being stored for future operations.

NUMBER OF GENERATORS TO BE EMPLOYED.

The number of generators will depend largely upon the size of the house, and they should be so arranged that the gas will be uniformly distributed throughout the inclosure. To secure this advantage, it is advisable that a number of generators be used rather than one large generator. Generators should be spaced from 20 to 25 feet apart, and in case of a light wind a few extra generators should be placed on the windward side of the house. An ounce to each jar is as small a dose as is practicable, unless the generators are well rounded inside at the base or well tilted.

EXPOSURES.

Short exposures with a greater strength of gas have been found more satisfactory than a weaker strength of gas overnight. In fact, better results will be gained if the exposures do not exceed one to two hours. An exposure of one hour is satisfactory in most instances. Short exposures also have the additional advantage of permitting the house to become thoroughly aerated previous to the rising of the sun.

VENTILATION AFTER FUMIGATION.

If there is a light wind, a ventilation of 10 to 15 minutes, using side and top ventilation, will be sufficient and will not lower the house temperature to a dangerous point unless it is close to zero weather outside. If it is a still evening and the outside temperature is not below 32° F., a 20 to 30 minute ventilation is satisfactory.

In case it is necessary to enter the house shortly after ventilation to determine the temperature, the person entering should not remain any longer than is necessary.

EFFECTS OF WEATHER CONDITIONS ON FUMIGATION.

TEMPERATURE.

Much experimentation has proved that excessive heat and cold will affect the results of fumigation. In most instances it is not advisable to fumigate if the temperature in the frame exceeds 70° F., or if the temperature is less than 55° F. It is possible that a variation of five degrees from the latter temperature will not result in serious injury to the plants, providing, of course, that the plants are not affected by such a low temperature.

LIGHT.

Light unquestionably affects fumigation. It has been known for a long time that it is very undesirable to fumigate when the sun is high. Furthermore, recent experiments have demonstrated that some injury may result to plants which have been subjected to fumes if, on the following day, the sun is very bright.

MOISTURE.

The question of moisture has received considerable attention from various fumigators, and it appears to be the consensus of opinion that excessive moisture in the presence of the gas does not increase the injury to plants and plant products under fumigation. A large number of plants have been fumigated in boxes immediately after syringing, when the leaves were covered with a film of water, with apparently no injury to the plants, and the insects on the plants were successfully controlled, which corroborates the experience of Morrill,[1] Quaintance,[2] and Woglum.[3]

Hydrocyanic-acid gas is readily soluble in water, and as a result the presence of excessive moisture in greenhouses decreases the effectiveness of the gas and consequently lessens the possibility of injury to the plants by burning. Fumigation experiments have been

[1] Bul. 76, Bur. Ent., U. S. Dept. Agr., p. 12, 1908.
[2] Bul. 84, Bur. Ent., U. S. Dept. Agr., p. 24, 31, 1909.
[3] Bul. 90, Bur. Ent., U. S. Dept. Agr., p. 68, 1912.

conducted where the plants, beds, and walks were thoroughly soaked with water, and the injury which would be expected under normal conditions to such plants as cosmos, rose geraniums, roses, heliotropes, and *Asparagus plumosus* did not appear, nor were such insects as aphids and thrips appreciably affected. It is obvious, therefore, that in order to increase the effectiveness of the fumigation the plants should be syringed not less than four or five hours prior to the liberation of the gas, to avoid undue absorption of the gas by the water on the benches and walks.

The difference in the results noted above may be accounted for by the fact that in the case of box fumigation only the foliage was covered with a film of water, whereas in the case of the greenhouse experiments not only the foliage of the plants was covered with a film of water but the entire soil surface of the house was soaked, and the water undoubtedly absorbed much of the available gas, reducing the toxic effect of the gas on the plants and insects.

HUMIDITY.

Recent tests have demonstrated that a relatively high humidity (98 to 100), with temperature varying from 70° to 75° F., greatly increases the amount of injury to the foliage of the plants, whereas plants in the presence of a relatively high humidity (98 to 100), with a temperature of 60° to 65° F., do not exhibit injury in excess of that which would appear if the plants were fumigated with an excessive dosage under normal atmospheric conditions. It is apparent, therefore, that a relatively high humidity alone is not responsible for injury unless accompanied by temperatures exceeding 70° F.

ADVISABILITY OF A FUMIGATION BOX.

A fumigation box is desirable for two reasons, namely, for testing the amount of gas plants can stand without injury, and for ridding a limited number of potted plants of insects, and thus avoiding costly and laborious hand scrubbing of such plants. The size of the box will depend on the use to which it is to be put. A box with a capacity of 200 cubic feet can be used advantageously for nursery stock, palms, etc.

Plants to be fumigated in a box in the daytime should remain in the box with the door closed at least one hour before the gas is generated and should be shaded from the bright sunlight for at least two hours after the completion of the exposure.

HOW INSECTS ARE DISSEMINATED FROM HOUSE TO HOUSE.

Doubtless many houses become infested with insects through the agency of plants commonly referred to as "boarders." The practice of turning over home-grown plants to a florist to care for during the

absence of the owner on a vacation is prevalent over the entire country, and often results in establishing pests not hitherto known to occur on the florist's premises. If the trade requires such a practice, plants of this character should be cleaned thoroughly of insect pests before being placed with the regular stock of the greenhouse.

Insect infestations in greenhouses have been traced to the following sources: Infested plants brought in from cold frames or propagation beds which have not received proper attention; cuttings, plants, and buds received from other establishments; and imported foreign or domestic stock. Adults of the greenhouse white fly, grasshoppers, beetles, aphids, etc., may enter through open ventilators from other houses or gardens; cutworms, wireworms, white grubs, etc., may be brought into the house with the soil; and roaches, ants, sowbugs, millipeds, etc., are sometimes brought in with packages, or they may crawl into the house through small openings.

COST OF HYDROCYANIC-ACID GAS FUMIGATION.

The economy in the use of hydrocyanic-acid gas as a means of controlling aphids, white flies, thrips, and the common greenhouse scale insects is apparent from the following figures, which are based on current prices:

Aphids can be controlled with a single fumigation at the rate of one-fourth ounce per 1,000 cubic feet at a cost of approximately ½ cent per 1,000 cubic feet. Tobacco fumigation with standard tobacco paper costs from 1½ to 3 cents per 1,000 cubic feet, and to secure a satisfactory control the operation must be repeated several times. Standard nicotine soap solution costs from 1 to 3 cents per gallon, and 4 gallons are required to cover plants which would occupy 1,000 cubic feet of space.

The greenhouse white fly can be controlled in three successive fumigations at the rate of one-half ounce of sodium cyanid per 1,000 cubic feet, with a total cost of 3 cents per 1,000 cubic feet for a complete control. Standard insecticides cost about 6 cents per 1,000 cubic feet for a single application, and fully four applications are required for a satisfactory control.

Thrips can be controlled on such plants as azaleas, lilies, and ferns with a single fumigation at the rate of one-half ounce of sodium cyanid per 1,000 cubic feet at a cost of 1 cent per 1,000 cubic feet. A single application of nicotine soap solution costs fully five times as much as the gas treatment and still gives only a partial control.

The common scale insects of greenhouses (excepting mealy bugs) can be controlled by fumigating the infested plants at the rate of three-fourths ounce of sodium cyanid per 1,000 cubic feet at a cost of 1½ cents per 1,000 cubic feet. The standard proprietary insecticides

commonly recommended for scale insects cost approximately 4 cents per gallon with an average cost of 16 cents per 1,000 cubic feet for each treatment. A 5 per cent homemade kerosene emulsion costs approximately one-half cent more per 1,000 cubic feet than does the gassing method, and gives very indifferent results.

The foregoing figures do not take into consideration the cost of labor. However, the time required for fumigation will not exceed the time required for the mixing and application of the sprays.

PRECAUTIONS.

Do not *guess* the amount of chemicals to be employed or the cubic contents of the house.

Do not fumigate plants in a greenhouse in daylight. (For box fumigation in daytime, see page 9.)

Do not fumigate when the temperature in the house is below 50° or above 70° F.

Do not leave the chemicals within reach of those unacquainted with their poisonous nature. Always have them properly labeled.

Do not handle the chemicals any more than is absolutely necessary, and always wash the hands thoroughly after doing so. It is well to have a pair of old gloves for this, and to use them for no other purpose.

Do not allow the acid to splash or drop on the clothing or skin.

Do not stay in the house any longer than is necessary to place the cyanid in the jars, and *never* enter a house charged with gas until it has been thoroughly aired.

Do not fail to post danger signs at all entrances before setting off the charge, and to see that the house is tightly closed.

Do not attempt to fumigate without adjusting the ventilators so that they may be operated from the outside.

Do not attempt to fumigate a large house alone.

Do not fumigate a frame adjoining a dwelling without notifying the occupants before fumigation and allowing them time to leave. Houses contiguous to fumigated frames should be aired thoroughly before the occupants are allowed to reenter.

Do not pour the water on the acid; pour the acid on the water.

Do not become negligent in any of the precautions; to do so may cause serious results.

PLANTS AND INSECTS FUMIGATED IN GREENHOUSES.

Table I is offered as a guide to those desiring to employ hydrocyanic-acid gas for controlling greenhouse pests. Space will not permit the inclusion of all plants which have been fumigated by the writers, but the table includes many ornamentals and a few tropical and subtropical plants commonly grown in greenhouses.

TABLE I.—*Plants and insects fumigated with hydrocyanic-acid gas in greenhouses.*

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
				°F.			
Abutilon sp	½	.....	1	70	Greenhouse white fly.	No burning	All stages except egg and late pupæ killed.
Do	½	.....	1	58	..do	..do	Do.
Do	¾	.....	1	68	..do	..do	Do.
Do	¾	.....	1	56	..do	..do	Do.
Abutilon vitifolia	½	.....	1	64	..do	..do	Do.
Do	½	.....	1	77	..do	..do	Do.
Acalypha sp	½	.....	1	60		..do	
Do	½	.....	1	64		..do	
Do	¾	.....	1	60		..do	
Achania sp	.....	½	¾	52		..do	
Do	.....	¾	1	....		..do	
Achyranthes sp	½	.....	1	58		..do	
Do	½	.....	1	64		..do	
Do	¾	.....	1	55		..do	
Do	¾	.....	1	60		..do	
Actinidia polygama	.....	1⅜	1	73		Slight burning	
Adenocalymma cosmosum	.....	5	¾	66		No burning	
Agave americana	¾	.....	1	68		..do	
Agave sp	.....	⅝	½	....		..do	
Ageratum sp	½	.....	1	64		..do	
Do	½	.....	1	58	Greenhouse white fly.	..do	All stages except eggs and late pupæ killed.
Do	½	.....	1	64	..do	..do	
Do	¾	.....	1	56	..do	..do	
Air plant	⅛	.....	1	70	Aphids	..do	100 per cent killed.
Do	¾	.....	1	68	..do	..do	Do.
Albizzia sp	.....	1⅜	1	73		Slight burning	
Aleurites sp	.....	1⅜	1	73		..do	
Alpinia nutans	½	.....	1	62		No burning	
Do	½	.....	1	74		..do	
Althaea sp	.....	1⅝	½	....	Aphids	..do	Do.
Amaranthus sp	¾	.....	1	55		..do	
Amaryllis sp	½	.....	1	60		..do	
Do	½	.....	1	70		..do	
Do	¾	.....	1	68		..do	
Annona cherimola	.....	⅝	½	....		..do	
Annona sp	.....	1⅜	1	73		Slight burning	
Antidesma bunius	.....	1⅜	1	73		..do	
Anthericum sp	½	.....	1	60	Long scale	No burning	80 per cent killed.
Do	½	.....	1	64		..do	
Do	¾	.....	1	60	Long scale	..do	100 per cent killed.
Anthurium sp	.....	⅝	½	....		..do	
Aralia guilfoylei	½	.....	1	66		..do	
Ardisia sp	½	.....	1	62		..do	
Do	½	.....	1	74		..do	
Araucaria excelsa	½	.....	1	66		..do	
Do	½	.....	1	77		..do	
Aristolochia sp	.....	5	¾	66		..do	
Artemisia sp	1⅜	.....	1	73		Slight burning	
Artillery plant	½	.....	1	70		No burning	
Asparagus plumosus	½	.....	1	66		Tips burned	
Do	½	.....	1	70		..do	
Do	½	.....	1	60		..do	
Do	¾	.....	1	68		Severe burning.	
Asparagus sprengeri	½	.....	1	60		Tender tips burned.	
Do	½	.....	1	70		No burning	
Do	¾	.....	1	68		Tender tips burned.	
Do	¾	.....	1	55		..do	
Aspidistra sp	½	.....	1	62		No burning	
Do	½	.....	1	74		..do	
Aster	½	.....	1	62		..do	
"Atamasco"	½	.....	1	64		..do	
Do	½	.....	1	76		..do	
Atropa sp	½	.....	1	64		..do	
Do	½	.....	1	76		..do	

TABLE I.—*Plants and insects fumigated with hydrocyanic-acid gas in greenhouses*—Continued.

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
				°F.			
Aucuba japonica	½		1	66		No burning	
Do	⅝		1	77		do	
Do	¾		1	68		do	
Avocado, see *Persea*.							
Azalea indica		5	¾	66		do	
Azalea sp	½		1	60	Thrips	do	95 per cent killed.
Do					Azalea lacewing.	do	100 per cent killed.
Do	¾		1	60	Azalea Eriococcus.	do	50 per cent killed.
Do	¾		1	55		do	
Do		5	¾	52		do	
Do		7½	1			Slight burning	
Bamboo		1½	1	73		Slight burning.	
Banana	½		1	60		No burning	
Do	⅝		1	55		do	
Basanacantha sp		1½	1	73		Severe burning.	
Begonia argenteoguttata	½		1	60	Orthezia	No burning	70 per cent killed.
Do	½		1	64		do	
Do	¾		1	60		do	
Begonia diadema	½		1	60		do	
Do	½		1	58		do	
Do	¾		1	56		do	
Begonia erfordii		5	¾	66		do	
Begonia manicata	½		1	60		do	
Do	½		1	58		do	
Do	¾		1	56		do	
Begonia metallica	½		1	66		do	
Do	½		1	77		do	
Begonia ricinifolia	½		1	60		do	
Do	½		1	58		do	
Do	¾		1	56		do	
Begonia saundersoni	½		1	58		do	
Do	½		1	64		do	
Do	¾		1	56		do	
Do	¾		1	60		do	
Begonia (Leopard)	½		1	66		do	
Do	⅝		1	77		do	
Begonia (Lorraine)	½		1	62		do	
Do	½		1	74		do	
Begonia (Rex)	½		1	66		do	
Do	½		1	77		do	
Berberis rehderiana	½		1	62		do	
Do	½		1	74		do	
Berberis thunbergii		1½	½		Aphids	Slight burning	100 per cent killed.
Berberis vulgaris		1½	½		do	do	Do.
Berberis sp		1½	1	73		do	
Belladonna	½		1	62		No burning	
Do	½		1	74		do	
Bougainvillea	½		1	58		do	
Do	½		1	60		do	
Do	¾		1	56		do	
Bradburya		1½	1	73		Slight burning.	
Bromelia sp		1½	1	73		Severe burning.	
Bunchosia sp		1½	1	73		Slight burning.	
Buxus sp. (boxwood)		5	¾	52		No burning	
Do		7½	1			do	
Cactus	½		1	70		do	
Do	¾		1	68		do	
Calla lily	½		1	64		do	
Do	½		1	76		do	
Do		5	¾	66		do	
Caladium sp	¾		1	55		do	
Do		⅝				do	
Camellia japonica		5	¾	52		do	
Camellia sp	¾		1	55		do	
Do		7½	1			do	

TABLE I.—*Plants and insects fumigated with hydrocyanic-acid gas in greenhouses*—Continued.

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
				° F.			
Camoensia sp		1¾	1	73		Slight burning.	
Canaga odorata	½		1	66		No burning	
Do	¾		1	77		do	
Canna	½		1	64		do	
Do	½		1	77		do	
Carica papaya		1¾	1	73		Slight burning	
Carissa carandas		⅝	½			No burning	
Do		1¾	1	73		Slight burning.	
Carnation	½			62		No burning	
Do	¾		1	76		do	
Do	¾		1	55		do	
Cassia beareana		1¾	1	73		Slight burning.	
Cassia fistula		1¾	1	73		do	
Catha edulis	½		1	66		do	
Do	¾		1	77		do	
Ceiba pentandra		1¾	1	73		do	
Centaurea	½		1	60	Onion thrips	do	95 per cent killed.
Cereus (night-blooming)	½		1	64		No burning	
Do		⅝	½			do	
Ceropegia thorncroftii		1¾	1	73		Severe burning.	
Chrysanthemum	¼		1	62		do	
Do	½		1	76	Aphids	do	100 per cent killed.
Do	¾		1	68		do	
Do		5	¾	66		do	
Cigar plant	½		1	70	Aphids	do	Do.
Do	¾		1	68		do	
Cineraria	¾		1	60		Old foliage burned.	
Cinnamomum camphora	½		1	66		No burning	
Do	¾		1	77		do	
Do	¾		1	68		do	
Citrus aurantium	½		1	60	Long scale	do	80 per cent killed.
Do	¾		1	55		do	
Citrus plumbago		5	¾	52		do	
Citrus sp	½		1	64		do	
Do		1¾	½		Florida red scale.	do	90 per cent killed.
Do		7½	1			do	
Do		10	1⅓			Tender foliage burned.	
Clianthus dampieri	½		1	62		No burning	
Do	¾		1	74		do	
Clerodendron		5	¾	66		do	
Cockscomb	½		1	64		do	
Coleus (Black Prince)	½		1	60	Orthezia	do	75 per cent killed.
Do	¾		1	66	do	Old foliage burned.	80 per cent killed.
Coleus (Firebrand)	½		1	60	do	No burning	75 per cent killed.
Do	¾		1	60	do	do	80 per cent killed.
Coleus (Golden bedder)	½		1	60	do	do	75 per cent killed.
Do	¾		1	60	do	Old foliage burned.	80 per cent killed.
Coleus (Golden Queen)	½		1	60	do	No burning	75 per cent killed.
Do	¾		1	60	do	do	80 per cent killed.
Coleus (Mrs. Hayes)	½		1	60	do	do	70 per cent killed.
Do	¾		1	60	do	do	80 per cent killed.
Coleus (Pfeister Red)	½		1	60	do	do	70 per cent killed.
Do	¾		1	60	do	do	80 per cent killed.
Coleus (Pfeister Yellow)	½		1	60	do	do	70 per cent killed.
Do	¾		1	60	do	do	80 per cent killed.
Coleus (Rose Bank)	½		1	60	do	do	70 per cent killed.
Do	¾		1	60	do	do	80 per cent killed.
Coleus (Shirrock Jr.)	½		1	60	do	do	70 per cent killed.
Do	¾		1	60	do	Old foliage burned.	80 per cent killed.
Coleus (Queen Victoria)	½		1	60	do	No burning	70 per cent killed.
Do	¾		1	60	do	do	80 per cent killed.

TABLE I.—*Plants and insects fumigated with hydrocyanic-acid gas in greenhouses*—Continued.

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
				°F.			
Coleus (Verschaffelti)	1/3	.....	1	60	Orthezia	No burning	70 per cent killed.
Do	3/8	.....	1	60	....do	....do	80 per cent killed.
Coleus (mixed)	1/2	.....	1	64	....do	....do	100 per cent killed.
Coreopsis	1/2	.....	1	62		....do	
Cosmos	1/2	.....	1	60		Tips burned	
Do	.....	1 3/4	1	73		Slight burning	
Cotton	1/3	.....	1	66		No burning	
Do	1/2	.....	1	77		....do	
Do	.....	5/7	1/2	....	Greenhouse white fly.	....do	All stages except eggs and late pupæ killed.
Croton (mixed varieties)	1/3	.....	1	58		....do	
Do	3/8	.....	1	77		....do	
Do	1/2	.....	1	56	Long scale	....do	100 per cent killed.
Do	.....	1 1/4	1/2	....		....do	
Cudrania javanensis	.....	1 4/5	1	73		Slight burning	
Cudrania tricuspidata	.....	1 4/5	1	73		....do	
Cyclamen	1/3	.....	1	58		No burning	
Do	1/2	.....	1	74		....do	
Do	3/4	.....	1	68		....do	
Cyphomandra sp	.....	1 3/4	1	73		Slight burning	
Daffodil	3/4	.....	1	55		No burning	
Do	.....	1 4/5	1	73		Severe burning of new foliage.	
Deutzia gracilis	.....	1 4/5	1/2	....	Aphids	No burning	100 per cent killed.
Deutzia scabra	.....	1 4/5	1/2	....		....do	
Digitalis	1/3	.....	1	62		....do	
Do	1/2	.....	1	74		....do	
Dioscorea pentaphylla	1/2	.....	1	64		....do	
Do	1/2	.....	1	76		....do	
Dracaena godseffiana	.....	5	5/6	66		....do	
Dracaena indivisa	.....	5	5/6	52		....do	
Do	.....	7 1/2	1	....		....do	
Entelea palmata	.....	1 7/8	1	73		Slight burning	
Erica sp	1/3	.....	1	64		No burning	
Do	3/8	.....	....	76		....do	
Epiphyllum sp	1/2	.....	1	64		....do	
Do	1/2	.....	1	76		....do	
Eupatorium sp	1/3	.....	1	58		....do	
Do	3/8	.....	1	60		....do	
Do	.....	1 3/7	1	73		Severe burning of young foliage.	
Ferns:[1]							
Adiantum cuneatum	3/4	.....	1	60		No burning	
Adiantum croweanum	3/4	.....	1	60		....do	
Birds nest	1/3	.....	1	70		....do	
Do	3/8	.....	1	68		....do	
Boston	1/3	.....	1	60		....do	
Do	3/8	.....	1	68		....do	
Holly	.....	5	3/4	52		....do	
Do	1/3	.....	1	62		....do	
Do	3/8	.....	1	60		....do	
Lastrea sp	1/3	.....	1	70		....do	
Do	3/8	.....	1	68		....do	
Nephrolepis scottii	3/4	.....	1	55		....do	
Nephrolepis scholzelii	3/4	.....	1	55		....do	
Nephrolepis whitmanii	1/2	.....	1	62		....do	
Do	3/4	.....	1	68		....do	
Polystichum sp	1/3	.....	1	70		....do	
Do	3/8	.....	1	60		....do	
Pteris sp	1/2	.....	1	60		....do	
Ficus utilis	.....	1 3/7	1	73		Slight burning of new growth.	
Ficus sp	.....	2 1/2	3/4	....	Cottony scale	No burning	All stages except eggs killed.

[1] *Asparagus plumosus* and *A. sprengeri* belong to the Lily family and are to be found under *Asparagus*.

TABLE I.—*Plants and insects fumigated with hydrocyanic-acid gas in greenhouses*—Continued.

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
				°F.			
Ficus sp		½	1	....	Thread scale	Severe burning; all leaves knocked. Injury largely due to close proximity of generator to plant.	All stages killed.
Forgetmenot		½	1	....		Severe burning of tender foliage.	
Forsythia viridissima		⅛	½	....	Aphids	No burning	100 per cent killed.
Freesia	¾		1	60		do	
Do	⅝		1	60		do	
Fuchsia	½		1	60	Greenhouse white fly.	do	All stages except eggs and late pupæ killed.
Do	¾		1	68	do	do	Do.
Do		5	¾	66		Slight burning	
Gaillardia sp	½		1	62		No burning	
Gardenia	½		1	60		do	
Do	¾		1	68		do	
Do		5	¾	66		do	
Do		½	1	....		Slight burning	
Genista	¾		1	55		No burning	
Do		5	¾	66		Flowers burned.	
Geraniums:							
Martha Washington	½		1	70	Aphids	New growth burned.	60 per cent killed.[1]
Do	½		1	70	do		100 per cent killed.[1]
Peppermint	½		1	70		No burning	
Do	¾		1	68		do	
Bedding	½		1	60	Greenhouse white fly.	do	All stages except eggs and late pupæ killed.
Do	¾		1	68	do	do	Do.
Rose	½		1	64		New growth burned.	
Gladiolus	½		1	62		No burning	
Do	⅜		1	55		do	
Heather (Scotch)	¾		1	70		do	
Do	¾		1	68		do	
Do		5	¾	52		Slight burning	
Do		½	⅔	....		do	
Heliotrope	½		1	64		No burning	
Do	¾		1	60		do	
Hibiscus sp	½		1	60		do	
Do	¾		1	55		do	
Hyacinth (water)	½		1	64		do	
Do	¾		1	55		do	
Hydrangea (French variety).	½		1	64		do	
Do	¾		1	60		do	
Ilex sp. (English)		5	¾	52		do	
Do		½	1	....		do	
Impatiens sultani	½		1	66	Aphids	do	100 per cent killed.
Do	¾		1	68		do	
Ipomoea sp. (morning glory).	½		1	64		do	
Do	¾		1	60		do	
Iris (Spanish)	½		1	64		do	
Do		5	¾	66		Tips burned	
Lantana sp	½		1	60	*Orthezia*	No burning	70 per cent killed.
Do	¾		1	56		do	
Laurus nobilis		5	¾	52	Soft brown scale.	do	Immature stages killed.
Do		½	1	....	do	do	90 per cent killed.

[1] The difference in results noted was due to the difference in the tightness of the two houses.

TABLE I.—*Plants and insects fumigated with hydrocyanic-acid gas in greenhouses*—Continued.

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
Lilies:				°F.			
Lilium formosum	½		1	60	Aphids	No burning	100 per cent killed.
Do	¾		1	60		do	
Lilium multiflorum	½		1	60	Aphids	do	Do.
Do	¾		1	60		do	
Chinese	½		1	55		do	
Water		5	¾	66		do	
Loquat		1½	1	73		Slight burning	
Mango	½		1	60		No burning	
Do	¾		1	55		do	
Do	5		½		Aphids	Slight burning	Do.
Marguerite	½		1	70	do	No burning	Do.
Do	½		1	60	Hemispherical scale.	do	95 per cent of immature scales killed.
Do	¾		1	68		do	
Marigold (French)	½		1	60		do	
Do	¾		1	64		do	
Mignonette	½		1	60		do	
Mimulus moschatus	½		1	70		do	
Do	¾		1	56		do	
Moon vine	½		1	60		Open flowers burned.	
Do	¾		1	60		Flowers and buds burned.	
Narcissus poeticus	¾		1	55		No burning	
Narcissus barri	½		1	55		do	
Nasturtium	¾		1	55		do	
Nigella	½		1	62	Aphids	do	100 per cent killed.
Do		1⅛	½			do	
Oleander	½		1	66		do	
Do		5	½	76		do	
Olive		⅐	½			do	
Orchid:							
Cattleya trianae	½		1	64		do	
Oxalis (flowering)	½		1	58		do	
Do	¾		1	56		do	
Palms:							
Areca lutescens	¾		1	60		do	
Chamaerops pumila	½		1	66		do	
Do	½		1	77		do	
Cocos sp		⅚	½			do	
Kentia belmoriana	½		1	60		do	
Do	¾		1	60		do	
Latania sp	¾		1	60		do	
Phoenix canariensis		5	¾	66		do	
Pandanus graminifolius	½		1	70		do	
Do	¾		1	68		do	
Pandanus veitchi	½		1	70		do	
Do	¾		1	68		do	
Pansy	½		1	62	Aphids	do	Do.
Do	¾		1	55	do	do	Do.
Pelargonium odoratissimum		1½	1	73		Slight burning	
Pelargonium sp	½		1	62		No burning	
Do	¾		1	68	Aphids	do	75 per cent killed.
Pentstemon		5	¾	52		do	
Do		7½	1			Slight burning.	
Persea americana		¾	1	55	Hemispherical scale.	No burning	100 per cent immature scales killed.
Do		1½	1	73		Slight burning.	
Do		¾	1	66	Avocado white fly.	No burning	All stages except eggs and late pupæ killed.
Petunia	½		1	60		do	
Poinsettia	½		1	62		do	
Pomegranate		⅐				do	
Poppy (Shirley)	½		1	60		do	

TABLE I.—*Plants and insects fumigated with hydrocyanic-acid gas in greenhouses*—Continued.

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
				° F.			
Primula chinensis	½	.....	1	58	.....	No burning...	
Do	¾	.....	1	56	.....	....do.....	
Do	.....	5	¾	66	.....	....do.....	
Primula malacoides	¾	.....	1	55	.....	....do.....	
Primula obconica	½	.....	1	58	Greenhouse white fly.	....do.....	All stages except eggs and late pupæ killed.
Do	¾	.....	1	55	.....	....do.....	
Psidium guajava	.....	⅝	½	....	.....	....do.....	
Do	.....	1¾	½	....	Long scale	....do.....	Immature stages killed.
Rhododendron	.....	5	¾	66	.....	....do.....	
Rhyncospermum sp	.....	7½	1	....	.....	....do.....	
Rosemary	½	.....	1	64	.....	....do.....	
Do	½	.....	1	76	.....	....do.....	
Rose	½	.....	1	64	.....	Tender growth burned.	
Do	½	.....	1	62	Rose leafhopper.	....do.....	100 per cent killed.
Do	.....	1¾	1	73	.....	....do.....	
Sage, scarlet	½	.....	1	74	.....	No burning...	
Do	½	.....	1	60	.....	....do.....	
Do	¾	.....	1	60	.....	....do.....	
Schizanthus sp	½	.....	1	60	.....	....do.....	
Do	¾	.....	1	56	.....	....do.....	
Scilla nutans	¾	.....	1	55	.....	....do.....	
Smilax	.....	5	¾	52	.....	....do.....	
Do	.....	7½	1	....	.....	Severe burning.	
Snapdragon	½	.....	1	60	.....	Tender tips burned.	
Do	¾	.....	1	60	.....	....do.....	
Spiraea cantoniensis	.....	1⅝	½	....	Aphids	No burning...	Do.
Spiraea latifolia	.....	1⅝	½	....	....do	....do.....	Do.
Spiraea thunbergii	.....	1⅝	½	....	....do	....do.....	Do.
Spiraea vanhouttei	.....	1⅝	½	....	....do	....do.....	Do.
Spiraea sp	¾	.....	1	60	.....	....do.....	
Stephanandra flexuosa	.....	1⅝	½	....	Aphids	....do.....	Do.
Stevhanotis floribunda	.....	5	¾	66	.....	....do.....	
Stevia sp	½	.....	1	60	.....	....do.....	
Stocks	½	.....	1	62	.....	....do.....	
Sweet peas	½	.....	1	62	Aphids	Tips and blossoms burned.	Do.
Thunbergia erecta	½	.....	1	64	.....	No burning...	
Do	½	.....	1	76	.....	....do.....	
Tulip	½	.....	1	55	.....	....do.....	
Verbena	½	.....	1	64	.....	....do.....	
Do	½	.....	1	60	.....	....do.....	
Verbena (lemon)	½	.....	1	64	.....	Tender growth burned.	
Vinca major variegata	½	.....	1	58	.....	No burning...	
Do	¾	.....	1	56	.....	....do.....	
Do	.....	5	¾	66	.....	....do.....	
Vinca rosea	½	.....	1	60	.....	....do.....	
Do	¾	.....	1	60	.....	....do.....	
Wandering Jew	½	.....	1	64	.....	Severe burning.	
Yucca	.....	5⅛	¾	....	.....	No burning...	

PLANTS AND INSECTS FUMIGATED IN FUMIGATION BOX.

To determine the susceptibility of the plants listed in Table II, these plants were fumigated in an air-tight box under favorable conditions. Not only were they fumigated in an inclosure much tighter than a greenhouse, but they also received dosages much in excess of those commonly used in greenhouse work.

TABLE II.—*Plants and insects fumigated with hydrocyanic-acid gas in fumigation box.*

Name of plant.	Rate in ounces per 1,000 cubic feet.		Exposure in hours.	House temperature.	Infestation.	Results of treatment.	
	Sodium cyanid.	Potassium cyanid.				On plants.	On insects.
				°F.			
Alternanthera sp	.....	5	½	76	.....	No burning	
Do	.....	10	1	73	.....	do	
Amaranthus sp	.....	⅘	½	....	.....	do	
Arenga mindorensis	.....	5	1	65	Long scale	do	100 per cent killed.
Atalantia glauca	.....	5	½	76	.....	do	
Do	.....	10	1	73	.....	do	
Banana	.....	10	¾	....	Citrus mealy bug.	Tender foliage burned.	Do.
Do	.....	5	1	....	do	No burning	95 per cent killed.
Belou glutinosa	.....	10	1	73	.....	do	
Carnation	.....	5	½	76	.....	Tender foliage burned.	
Catha edgmuthi	.....	2½	¾	....	Long scale	No burning	60 per cent killed.
Croton	2½	.....	¾	60	do	do	Do.
Do	5	.....	¾	66	do	do	100 per cent killed.
Do	10	.....	¾	68	do	do	Do.
Ferns:							
Boston	2½	.....	1	60	Larvæ Florida fern caterpillar.	do	40 per cent killed.
Do	5	.....	¾	62	do	do	100 per cent killed.
Do	7½	.....	¾	68	do	do	Do.
Do	10	.....	1	68	do	Tender growth burned.	Do.
Do	.....	5	½	76	Aspidistra scale.	No burning	All stages except egg killed.
Adiantum cuneatum	2½	.....	1	60	Larvæ Florida fern caterpillar.	do	40 per cent killed.
Do	5	.....	¾	62	do	do	100 per cent killed.
Do	7½	.....	¾	68	do	do	Do.
Do	10	.....	¾	68	do	Tender growth burned.	Do.
Nephrolepis whitmanii	5	.....	¾	66	do	No burning	Do.
Opuntia	.....	5	¾	....	.....	do	
Do	.....	10	¾	....	.....	do	
Orchids (in growing condition):							
Angraecum eburneum	5	.....	1	62	*Diaspis* sp	Slight burning.	Do.
Cypripedium sp	5	.....	1	62	.....	No burning	
Coelogyne flaccida	5	.....	1	62	Chaff scale	do	Do.
Coelia baueriana	5	.....	1	62	.....	do	
Dendrobium fimbricatum.	5	.....	1	62	*Lepidosaphes* sp.	do	Do.
Schomburgkia undulata	5	.....	1	62	.....	do	
Orchids (dormant):[1]							
Cattleya trianae	20	.....	¾	70	.....	do	
Cattleya sp	.....	20	¾	....	.....	do	
Do	.....	21	1	....	.....	do	
Do	.....	42	½	....	.....	Slight burning; plant recovered.	
Osbeckia stellata	.....	5	1	58	Long scale	No burning	Do.
Palms:							
Kentia belmoreana	.....	5	½	....	Palm mealy bug and palm aphids.	do	Do.
Areca lutescens	.....	10	1	65	Tessellated scale.	Old foliage burned.	Do.
Corypha elata	.....	5	1	58	Long scale	No burning	Do.
Phoenix sp	.....	10	1	73	.....	do	
Pandanus veitchii	.....	10	1	73	Florida red scale.	do	Do.

[1] Imported orchids without new growths.

In order that there may be no confusion on the part of the reader as to the insects referred to in the tables by their common names, both their common and scientific names are listed herewith:

Greenhouse white fly—*Trialeurodes vaporariorum* (Westw.).
Citrus mealy bug—*Pseudococcus citri* (Risso).
Long-tailed mealy bug—*Pseudococcus adonidum* (L.).
Palm or avocado mealy bag—*Pseudococcus nipae* (Mask.).
Greenhouse Orthezia—*Orthezia insignis* (Dougl.).
Florida red scale—*Chrysomphalus ficus* (Ashm.)
Long scale—*Coccus elongatus* (Sign.).
Soft brown scale—*Coccus hesperidum* (L.).
Palm aphis—*Cerataphis latanae* (Boisd.).
Hemispherical scale—*Coccus hemispherica* (Targ.).
Florida fern caterpillar—*Eriopus floridensis* (Guen.).
Aspidistra scale—*Hemichionaspis aspidistrae* (Sign.).
Tessellated scale—*Eucalymnatus tessellatus* (Sign.).
Azalea Eriococcus—*Eriococcus azaleae* (Horv.).
Azalea lacewing—*Stephanitis azaleae.* (Horv.).
Greenhouse thrips—*Heliothrips haemorrhoidalis* (Bouché).
Onion thrips—*Thrips tabaci* (Lind.).
Cottony scale—*Pulvinaria* sp.
Thread scale—*Ischnaspis longirostris* (Sign.).
Avocado white fly—*Trialeurodes floridensis* (Quaint.).
Rose leafhopper—*Typhlocyba rosae* (L.).
Chaff scale—*Parlatoria proteus* (Curt.).

CONCLUSION.

The results indicated in the foregoing pages are for the most part based on the fumigation of commercial houses under commercial conditions. The slight variations in the percentage of insects killed and injury to plants may be accounted for by the tightness or lack of tightness of different houses. It is obvious, therefore, that it is not practicable to give specific directions as to the amount of cyanid to be employed under all conditions. A knowledge of the pests to be controlled and of the condition of the plants and tightness of the house under consideration will render it possible to determine the dosage to be used.

In fumigating a house containing a large variety of plants, using the correct dosage and under proper conditions, it happens occasionally that some plants appear to have been injured. However, this injury is not permanent, as the plants will show new vigorous growth in a short time. Repeated tests have demonstrated thoroughly that the growth of many plants is stimulated by hydrocyanic-acid gas.

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